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RTCM RECOMMENDED STANDARDS FOR MARINE RADAR EQUIPMENT INSTALLED ON SHIPS OF LESS THAN 300 TONS GROSS TONNAGE

VERSION 1.1

DEVELOPED BY
RTCM SPECIAL COMMITTEE NO. 112

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RTCM RECOMMENDED STANDARDS FOR MARINE RADAR EQUIPMENT INSTALLED ON SHIPS OF LESS THAN 300 TONS GROSS TONNAGE

APPLICATION

This RTCM Standard applies generally to ships of less than 300 tons gross tonnage. It should be noted, however, that it does not apply after February 1, 1995 to passenger ships subject to the International Convention for the Safety of Life at Sea (SOLAS), 1974 as amended, unless prescribed by national regulations under the exemption authority of the SOLAS Convention.

GENERAL

2.1 The radar equipment shall provide an indication, in relation to the ship, of the position of other surface craft and obstructions and of buoys, shorelines and navigational marks in a manner which will assist in navigation and in avoiding collision.

2.2 Equipment shall be installed in such a manner that it is capable of meeting the performance requirements specified herein.

2.3 The equipment, including facilities which are provided in addition to those required herein, shall enhance the safety of navigation.

2.4 Where an item of equipment provides a facility which is additional to the minimum requirements of this performance specification the operation and, as far as is reasonably practical, the malfunction of such additional facility shall not degrade the performance of the equipment below the minimum standards of this performance specification.

PERFORMANCE REQUIREMENTS

All radar installations shall comply with the following minimum requirements as specified in paragraphs 3 through 12 herein.

Range Performance

The operational requirement under normal propagation conditions, when the radar antenna is mounted at a height of 15 meters above sea level, is that the equipment shall in the absence of clutter give a clear indication of (the 15 meter height is a test criteria only and not an installation requirement);

3.1.1 Coastlines

At 20 nautical miles when the ground rises to 60 meters.

At 7 nautical miles when the ground rises to 6 meters.

3.1.2 Surface Objects

At 7 nautical miles a ship of 5,000 tons gross tonnage, whatever her aspect.

At 3 nautical miles a small vessel of 10 meters in length.

At 2 nautical miles an object such as a navigational buoy having an effective echoing area of approximately 10 square meters.

3.2 Minimum Range

The surface objects specified in 3.1.2 shall be clearly displayed from a minimum range of 50 meters up to a range of one nautical mile, without changing the setting of controls other than the range selector.

Note:The minimum range is the shortest distance at which, using the mandatory range scale of 0.75 to 0.8 nautical miles, a target is still presented separately from the point representing the antenna position.

3.3 Display

3.3.1 Display Requirements For All Ships:

3.3.1.1 Optical magnification may be employed provided the display so magnified remains within the accuracy limitations of this specification.

3.3.1.2 Any information not associated with the use of the radar picture for navigational or collision avoidance purposes may be shown only outside the effective diameter of the display.

3.3.1.3 A means of plotting target track history shall be provided.

3.3.1.4 The equipment shall provide the following range scales of display: .25, .5, .75 to .8, 1.5, 3, 6, 12 and 24 nautical miles. For Category III ships a maximum range scale of 12 miles is acceptable.

3.3.1.5 Additional range scales may be provided.

3.3.1.6 These additional range scales shall be either smaller than the smallest range scale or greater than the greatest range scale required by paragraph 3.3.2.

3.3.1.7 Range scales with delayed sweep origins shall not be provided.

3.3.1.8 The range scale displayed and the distance between range rings shall be clearly indicated at all times.

3.3.2 Additional Display Requirements For Category I Ships:

3.3.2.1 The equipment shall without external magnification provide a relative plan display in the head-up unstabilized mode with an effective diameter[1] of not less than 180 millimeters which corresponds to a 9-inch cathode ray tube.

3.3.3 Additional Display Requirements for Category II Ships:

3.3.3.1 The equipment shall provide a relative plan display in the head-up unstabilized mode with a radar display size adequate to meet the system discrimination requirements of para 3.7.

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[1] The effective diameter of the display is the diameter of the central area into which any angular scale marking around its edge does not intrude. In the case of displays which are other than circular their smallest effective dimension is the effective diameter.

3.4 Range Measurement[2]

3.4.1 Fixed electronic range rings shall be provided for range measurements as follows:

3.4.1.1 On the range scales of 0.75 to 0.8 nautical miles and shorter as provided in par. 3.3.1.4 above, at least two range rings shall be provided; and on each of the other range scales six range rings shall be provided.

3.4.1.2 Where off-setting facilities are included in the equipment additional range rings shall be provided on each range scale so that the range rings extend from the point of maximum off-set to the edge of the display farthest from that point. On each range scale the distances between the additional range rings shall be the same as the distances between the range rings provided in accordance with 3.4.1.1.

3.4.2 A variable electronic range marker with a numeric readout of range shall be provided.

3.4.2.1 The range of the variable range marker shall extend at least from 0.25 nautical mile to the maximum range of the greatest range scale.

3.4.3 The fixed range rings and the variable range marker shall enable the range of an object to be measured with an error not exceeding 1.5 percent of the maximum range of the scale in use, or 70 meters, whichever is the greater.

3.4.4 For other than raster scan radars it shall be possible to vary the brilliance of the fixed range rings and the variable range marker and to remove them completely from the display. For raster scan radars it shall be possible to remove the rings and marker from the display.

3.4.4.1 The fixed and variable range markers shall be capable of being switched on and off independently.

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[2] Range measurement is the determination of the distance of a target from the radar antenna.

3.5 Heading Indicator

3.5.1 The heading of the ship shall be indicated by a line on the display with a maximum error not greater than plus or minus 1 degree. The thickness of the displayed heading line shall not be greater than 0.5 degree.

3.5.1.1 The heading of the ship shall be indicated electronically by a line on the display extending from own ship's position to the edge of the display.

3.5.1.2 It shall be possible to adjust the heading marker with an accuracy equal to or better than 0.5 degree.

3.5.2 Provision shall be made to switch off the heading indicator by a device which cannot be left in the "heading marker off" position.

3.5.2.1 Where a brightness control is provided for the heading line it shall not dim the heading line to extinction.

3.6 Bearing Measurement

3.6.1 Provision shall be made to obtain quickly the bearing of any object whose echo appears on the display.

3.6.2 The means provided for obtaining bearings shall enable the bearing of a target whose echo appears at the edge of the display to be measured with an accuracy of plus or minus 1 degree or better.

3.7 Discrimination

3.7.1 The equipment shall be capable of displaying as separate indications on a range scale of 1.5 nautical miles or less, two small similar targets at a range of between 50 percent and 100 percent of the range scale in use, and on the same azimuth, separated by not more than 50 meters in range.

3.7.2 The equipment shall be capable of displaying as separate indications two small similar targets both situated at the same range between 50 percent and 100 percent of the 1.5 mile range scale, and separated by not more than 2.5 degrees in azimuth. For Category III ships a separation of not more than 4.7 degrees is acceptable.

Note: The two small similar targets used to show compliance with paragraphs 3.7.1 and 3.7.2 shall each have an effective echoing area of approximately 10 square meters.

3.8 Roll or Pitch

The performance of the equipment shall be such that when the ship is rolling or pitching up to plus or minus 10 degrees the range performance requirements of 3.1 and 3.2 continue to be met.

3.9 Scan

The scan shall be clockwise, continuous and automatic through 360 degrees of azimuth. The scan rate shall be not less than 12 revolutions per minute. The equipment shall operate satisfactorily in relative wind speeds of up to 70 knots.

3.9.1 If the radar is to be operated in conjunction with an Automatic Radar Plotting Aid (ARPA) the scan rate shall be not less than 20 rpm for radar range scales up to 16 nautical miles.

3.10 Azimuth Stabilization

3.10.1 Azimuth Stabilization Requirements By Ship Category:

3.10.1.1 Azimuth stabilization is mandatory for Category ALFA ships.

3.10.1.2 Azimuth stabilization is optional for Category BRAVO ships.

3.10.2 Azimuth Stabilization Performance Requirements For All Ships With Azimuth Stabilization:

3.10.2.1 Azimuth stabilization must not degrade the performance of the radar. The accuracy of alignment with the compass transmission shall be within 0.5 degrees, with a compass rotation rate of 2 revolutions per minute.

3.10.2.2 The radar equipment shall include means by which the display can be used in the head-up mode. If other presentations are possible, changeover from, one presentation to another shall be possible with an accuracy of 0.5 degrees within 15 seconds.

3.11 Tuning

Means shall be available at the display viewing position to confirm correct tuning of the equipment without the presence of targets.

3.12 Anti-clutter Devices

Suitable means shall be provided for the suppression of unwanted echoes from sea clutter, rain and other forms of precipitation, clouds and sandstorms. It shall be possible to adjust manually and continuously the anti-clutter controls. Anti-clutter controls shall be inoperative in the fully anti-clockwise positions. In addition, automatic anti-clutter controls may be provided; however, they must be capable of being switched off.

3.12.1 Adjustment of anti-clutter controls in small discrete steps shall be regarded as continuous adjustment. Additionally, adjustment by controls which operate by other than circular movement are acceptable on condition that:

(i) If they operate by linear movement they shall be inoperative in the fully left or fully down position or

(ii) If they operate by a pair of push buttons it shall be operation of the left or lower button which shall render the device inoperative.

An indication of the operative conditions of the anti-clutter control shall be provided.

3.13 Operation

3.13.1 The equipment shall be capable of being switched on and operated from the display viewing position.

3.13.2 Operational controls shall be accessible and easy to identify and use. Where symbols are used, compliance with the recommendations of the International Maritime Organization on symbols for controls on marine navigational equipment is recommended.

3.13.2.1 Adequate illumination shall be provided to enable identification of controls and facilitate reading of displays at all times. Facilities for dimming shall be provided.

3.13.2.2 The controls shall be identified in English. Additionally the symbols given in the IMO Resolution A.278 (VIII) may be used. Where no appropriate symbols exist in A.278, those of IEC Publication 417[3] should be used.

3.13.2.3 The number of operational controls, their design and manner of function, location, arrangement and size shall provide for simple, quick and effective operation. The controls shall be arranged in a manner which minimizes the chance of inadvertent operation.

3.13.2.4 Equipment shall be so constructed that it is capable of being operated properly and readily by a suitably qualified member of the ship's staff.

3.13.3 After switching on from cold the equipment shall become fully operational within 4 minutes.

3.13.4 A standby condition shall be provided from which the equipment can be brought to an operational condition within 15 seconds.

3.13.5 If a viewing hood or sunshade is necessary to facilitate operation in high ambient light levels, then means shall be provided for its ready attachment and removal.

3.13.6 If, for any reason (e.g. failure of the antenna to rotate), the current target information is more than 10 seconds old, a warning shall appear.

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[3] IEC Publication 417: Graphical Symbols for use on equipment.

3.14 Interference from external magnetic fields

3.14.1 After installation and adjustment on board, the bearing accuracy as prescribed in this specification shall be maintained without further adjustment irrespective of the movement of the ship in the earth's magnetic field.

3.14.1.1 The effect of external magnetic fields shall be sufficiently restricted to ensure that the bearing accuracy will be maintained after installation and adjustment on board.

3.15 Antenna Syst

The antenna system shall be installed in such a manner that the design efficiency of the radar system is not substantially impaired.

3.16 Operation with radar beacons

3.16.1 All radars operating in the 9 GHz (3 centimeter) band shall be capable of operating in a horizontally polarized mode.

3.16.1.1 All radars operating in the 3 GHz (10 centimeter) band may operate with either horizontal or vertical polarization.

3.16.2 The radar shall be operationally compatible with radar beacons (racons) which conform to the standards recommended by the International Maritime Organization and the International Telecommunications Union for the appropriate frequency band.

4. MULTIPLE RADAR INSTALLATION

4.1 Where two radars are required to be carried they shall be so installed that each radar can be operated individually and both can be operated simultaneously without being dependent upon one another. When an emergency source of electrical power is provided, both radars shall be capable of being operated from this source.

4.2 Where two radars are fitted, interswitching facilities may be provided to improve the flexibility and availability of the overall radar installation. They shall be so installed that failure of either radar will not cause the supply of electrical energy to the other radar to be interrupted or adversely affected.

POWER SUPPLY

5.1 Equipment shall continue to operate in accordance with the requirements of the relevant specification in the presence of variations of the power supply normally to be expected in a ship.

5.1.1 The equipment shall be capable of normal operation when encountering the following variations of the input power supply:

AC Variation from nominal voltage	- 10% + 10%
Variation from nominal frequency	± 6%
DC Variation from nominal voltage:	
Generator type supplies	20% + 10%
Battery supplies	10% + 30%

5.2 Means shall be incorporated for the protection of equipment from the effects of excessive current and voltage, transients and accidental reversal of the power supply polarity.

5.2.1 The equipment shall have impulse voltage transient protection from transients with amplitude of ± 1200 peak volts, rise times of 2 microseconds to 10 microseconds and durations of up to 20 microseconds.

5.3 If provision is made onboard ship for operating equipment from more than one source of electrical energy, arrangements for rapidly changing from one source of supply to the other shall be incorporated.

DURABILITY AND RESISTANCE TO ENVIRONMENTAL CONDITIONS

6.1 The equipment shall be capable of continuous operation under the conditions of sea states, vibration, humidity and temperature likely to be experienced in the ship in which it is installed.

6.2 The equipment shall be divided into two classes, namely:

Class B - equipment or units intended to be protected from the weather

Class X - equipment or units intended to be exposed to the weather

6.2.1 Each unit of the equipment shall be marked to indicate the class for which it is intended. Where symbols are used for this purpose the appropriate I.E.C. symbol shall be used. These are:

For enclosed equipment - a square inside a circle as shown in Figure 1.1.

For exposed equipment - a square surmounted by two slanting, dotted lines as shown in Figure 1.2.

6.3 The equipment shall comply with the provisions of Appendix A, a performance specification of the climatic and durability testing of marine radar equipment.

ELECTRICAL INTERFERENCE

7.1 All reasonable and practicable steps shall be taken to eliminate the causes of, and to suppress, electromagnetic interference between the equipment concerned and other equipment on board.

7.2 Equipment shall be of a type authorized by the Federal Communications Commission (FCC). Specifications for limitations of electrical interference may be found in the FCC Rules.

MECHANICAL CONSTRUCTION

8.1 Mechanical noise from all units shall be so limited as not to prejudice the hearing of sounds on which the safety of the ship might depend.

8.2 Equipment shall be so constructed and installed that it is readily accessible for inspection and maintenance. Inadvertent access to dangerous voltages within equipment shall be prevented.

8.3 Equipment shall be provided with an external indication of manufacturer, the equipment type or model identification and the serial number of the unit.

PROTECTIVE ARRANGEMENTS

General

The equipment shall be designed so that access to hazardous voltages may only be gained by means of a servicing tool or security key.

Labels warning of high voltages shall be prominently displayed near all places such voltages exist.

Additionally, the radar shall incorporate personnel-protecting devices against known voltage hazards.

All terminal boards carrying circuits of 250 volts or higher shall be covered.

9.2 Radio frequency radiation

9.2.1 If the operation of the radar would result in exposure of workers or other personnel to levels of radio frequency radiation in excess of the "Radio frequency Protection Guides" recommended in "American National Standard Safety Levels with Respect to Human Exposure to Radio Frequency Fields, 300 kHz to 100 GHz" (ANSI C95.1-1982), issued by the American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10081, and copyright 1982 by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, New York 10017 a warning label must be installed in clear view near the point where this radiation is emitted. This warning label shall be in accordance with "American National Standard Radio Frequency Radiation Hazard Warning Symbol" (ANSI C95.2-1982) issued and copyrighted as noted above. This label shall, in addition to the warning symbol, display the distance in meters at which the recommended safe level of human exposure would be reached. For the marine radar frequencies this level from ANSI C95.1-1982 is 50 watts per square meter (5 mW/cm^2) averaged over any six minute period.

9.2.2 The maximum distances from the antenna at which radio frequency radiation levels of 100 watts per square meter (10 mw/cm^2), 50 watts per square meter (5 mw/cm^2) and 10 watts per square meter (1 mw/cm^2) can be expected shall be included in the equipment handbook (Instruction manual).

9.2.3 Radiation from the antenna shall be possible only when the beam is scanning, except that override facilities may be provided for maintenance purposes.

9.3 X-ray radiation

9.3.1 External x-ray radiation from the equipment in its normal working condition shall not exceed the limits recommended by the OSHA Standards (Code of Federal Regulations, Title 29, Chapter XVII, paragraph 1910.96).

10. MANUFACTURERS' LIMITATIONS

Where reasonable limitations are known to exist, e.g. maximum lengths of interconnecting cable, the manufacturer shall include such limitations in his installation instructions.

11. INSTRUCTION MANUAL

Information shall be provided to enable suitably qualified members of a ship's staff to operate and maintain equipment efficiently.

12. MAGNETIC COMPASS SAFE DISTANCE

Each unit of equipment normally to be installed in the vicinity of a standard or a steering magnetic compass shall be clearly marked with the minimum safe distance at which it may be mounted from such compasses.

Appendix A
to
RTCM Recommended Standards For
Marine Radar Equipment Installed On
Ships Of Less Than 300 Tons Gross Tonnage

DESIGN AND TESTING SPECIFICATIONS

General

The manufacturer shall certify that his equipment has been designed, manufactured, and tested to meet the following environmental standards.

2. Classification of Marine Equipment

For the purpose of these tests, Marine Radar Units shall be divided into two classes, viz:

Class B - Units intended for use below deck or in a deckhouse, e.g., radio office, chart room, enclosed bridge or wheelhouse.

Class X - Units intended for use in exposed locations.

Environmental Standards

(a) The testing shall be as follows:

Applicable to Class:

X,B	Visual Inspection and Performance Test
X,B	Dry Heat Cycle
X,B	Damp Heat Cycle
X,B	Low Temperature Cycle
X,B	Inspection under Vibration
X	Rain Test
X,B[4]	Corrosion Test
X,B	Mold Growth Test
X,B	Visual Inspection and Performance Test

(b) Unless otherwise specified, power shall be supplied to the equipment only during the period specified for the electrical tests.

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[4] As noted in Paragraph 10.

(c) When power is applied to the equipment during the tests, it shall be at the nominal voltage.

(d) A performance check is a shortened form of operational testing to the standards required by the Marine Radar Performance Specification, such as could be carried out in 5 to 15 minutes. This time does not include a period of pre-heating in cases where delayed switching is used.

4. Visual Inspection and Performance Test

After each phase of the testing sequence, the equipment shall be visually inspected to determine that it is acceptable.

5. Dry Heat Cycle

(a) Class B Equipment

The equipment shall be placed in a chamber which is maintained at a constant temperature of +55°C (±3°C) for a period of 10 hours, after which it shall be kept working continuously for a period of 2 hours at that temperature. A performance check shall be carried out during the last 30 minutes of the test period.

(b) Class X Equipment

(i) The equipment shall be placed in a chamber which is maintained at a constant temperature of +70°C (±3°C) for a period of 10 hours.

(ii) The chamber shall then be cooled to +55°C (±3°C) and the equipment shall be kept working continuously at that temperature for a period of 2 hours.

(iii) At the end of 2 hours, the equipment shall be subjected to a performance check at a temperature of +55°C (±3°C).

(c) Class B and Class X Equipment

At the conclusion of the performance check, the equipment shall be exposed to normal room temperature (+20°C) for at least 3 hours before the damp heat cycle.

Damp Heat Cycle - Applied to Both Class B and Class X Equipment

(a) The equipment shall be placed in a chamber which within a period not exceeding 2 hours shall be heated from room temperature to +40°C (±3°C) and shall be brought to a relative humidity of not less than 95%.

(b) The chamber shall be maintained at a temperature of +40°C (±3°C) for a minimum period of 12 hours and at a relative humidity of not less than 95%.

(c) At the beginning of the last 60 minutes of the above period, all accessible surfaces and components may be wiped dry and fans and any sources of heat provided in the equipment may be switched on.

(d) During the last 30 minutes of the period referred to in Paragraph (b), above, and while the temperature of the chamber is still +40°C (±3°C) at a relative humidity of not less than 95%, the equipment shall be subjected to a performance check.

(e) The temperature shall then be allowed to fall below +25°C in not less than 1 hour, while the equipment is enclosed in the chamber, and shall then be expected to normal room temperature (+20°C) and humidity for a period of 3 to 6 hours before the Low Temperature Cycle.

Low Temperature Cycle

(a) Class B Equipment

(i) The equipment shall be placed in a chamber, which is maintained at a temperature of -15°C (±3°C) at normal atmospheric pressure for a minimum period of 12 hours.

(ii) During the last 30 minutes of the above period, the equipment shall be subjected to a performance check at the controlled temperature. (If built-in heaters are provided in radar equipment, these may be switched on 30 minutes before the performance check is carried out.)

(b) Class X Equipment

(i) The equipment shall be placed in a chamber, which is maintained at a temperature of -25°C (±3°C) at normal atmospheric pressure for a minimum period of 12 hours.

(ii) During the last 30 minutes of the above period, the equipment shall be subjected to a performance check at the controlled temperature. (If built-in heaters are provided in radar equipment, these may be switched on 30 minutes before the performance check is carried out.)

Vibration Standards (Class B and Class X)

(a) The equipment, complete with its chassis covers and shock absorbers (if supplied), shall in its normal operating position be clamped to a vibration table.

(b) The table shall be vibrated at frequencies between:

(i) 5 hertz and 12.5 hertz with an excursion of ±1.60 millimeter (±0.063 inch).

(ii) 12.5 hertz and 25 hertz with an excursion of ±0.38 millimeter (±0.015 inch).

(iii) 25 hertz and 50 hertz with an excursion of ±0.10 millimeter (±0.004 inch).

Each range of frequencies shall be explored in not less than 8 minutes, during which periods the equipment shall be kept working continuously.

(c) A performance check shall be carried out during the above test.

(d) Vibrations shall be applied in three mutually perpendicular directions.

Rain Test (Class X Only)

A solid stream of water from a 13 millimeter (0.5 inch) or larger diameter garden type hose and nozzle connected to a normal domestic supply (2.5 to 3.5 kg/cm^2) (35 to 50 psi) shall be directed at the equipment from all angles at a distance of 3 meters (10 feet) for a period of 30 minutes.

10. Corrosion Test

The corrosion test may be waived where the manufacturer is able to produce evidence that the components, materials and finishes employed in the equipment would satisfy the test.

For Class X equipment and sample exterior materials and finishes; for Class B equipment as may be required by the type testing authority.

(a) Salt Water

(i) The equipment shall be sprayed with a fine mist, such as would be produced by a spray gun ejecting cold tap water, containing the following salts in solution:

Sodium Chloride	2.7%
Magnesium Chloride	0.6%
Calcium Chloride	0.1%
Potassium Chloride	0.07%

The quantity of each salt shall be subjected to a tolerance of ±10%.

(ii) The equipment shall be sprayed on all its external surfaces with the salt solution for a period of 1 hour and shall be kept working continuously for the last 30 minutes thereof.

(iii) This spraying shall be carried out four times with a storage period of 7 days at +40°C (±3°C) between the repetitions. The relative humidity during storage shall be greater than 60%.

(iv) At the conclusions of the total period, the equipment shall be visually examined. There shall be no undue deterioration or corrosion of the metal parts, finishes, materials, or component parts. The equipment shall then be subjected to a performance check. In the case of hermetically sealed equipments, there shall be no evidence of moisture penetration on opening the cover.

11. Mold Growth Test

All materials used in the radar system should inhibit fungus growth.